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Remarks

Thorough examination by the Examiner is noted and appreciated.

The claims have been amended to further clarify Applicants invention and define over the prior art. No new matter has been added.

Support for the amendments is found in the previously presented claims.

Claim Rejections under 35 USC 103

1. Claims 1-4, 6-7, 9, 20-28, and 31-33 stand rejected under 35 USC 103(a) as being unpatentable over Dible et al. (US 6,239,403) in view of Liu et al. (US 2003/0038112).

Dible et al. discloses a power segmented electrode which is individually supplied with RF power to provide for uniform processing of a substrate (see Abstract). In one embodiment, Dible et al. discloses a segmented electrode and an **active mechanism** to control power delivered to different zones of the segmented electrode including a **capacitive network** for

distributing power to a plurality of electrodes which may be segmented into concentric annular rings (see Figure 5, col 3, lines 30-49;; col 4, lines 54-61; col 6, lines 13-24).

In a different embodiments, Dible et al. (Figure 1a and Figure 2) also discloses a passive network system that is incorporated into a bipolar electrostatic chuck (Figure 1a) (col 5, lines 16-24) and may use a DC bias to provide for electrostatic clamping (Figure 2; col 5, lines 49-51) and which includes a **passive RF power splitter** (26; Figure 2) for delivering power to different segments of the segmented electrode (col 5, lines 37-57).

Dible et al. **does not disclose** that the embodiment with a capacitive network (Figure 5) is incorporated into an electrostatic chuck. Dible et al. **does disclose that** two variable capacitors may be used to supply RF power to each pole of an ESC wafer clamping system (Figure 6; col 6, line 23-29) where the first electrode (8) is separate from the chuck which acts as a second electrode (6) (see Figure 1a)).

Dible et al. further discloses that the embodiment with a capacitive network (Figure 5) (active network) includes a

plurality of variable capacitors (22) and a plurality of current sensors (24) to provide active control of the variable capacitors by means of **a feedback loop between the current sensors and the variable capacitors** to control the **percentage of power** sent to the electrodes (col 6, lines 13-24). Dible et al. teaches that the capacitors are automatically adjusted by signals from the current sensors to compensate for deviations from uniformity of **processing the substrate in an annular zone of the substrate facing a respective one of the annular electrodes** (col 2, lines 41-47).

Thus Dible fails to disclose several elements of Applicants invention, including those elements in **bold type**:

"A method of controlling the **spatial distribution of RF power** used to generate a plasma for processing a semiconductor device process wafer to achieve a uniform density of said plasma **over an entire face of said process wafer**, comprising the steps of:

(a) **producing RF power from a single RF generator comprising a dual frequency system;**

(b) delivering the RF power to each of a plurality of separate electrode zones **according to a matching network**, said RF power **individually deliverable to separate electrode zones** at a selected RF power level **according to a capacitor network comprising a plurality of variable capacitors arranged in parallel**, each of said separate electrode zones associated with one of said variable capacitors, said separate electrode zones comprising an electrostatic chuck; and

(c) separately controlling the RF power delivered to each of the electrode zones **so as to produce a desired spatial distribution of RF power in response to determining a density of said plasma across said process wafer face, said desired spatial distribution of RF power selected to achieve a uniform density of said plasma across said entire surface of said process wafer."**

Examiner argues that Dible teaches impedance matching and refers to discussion in the prior art (col 1, lines 41-49) that discloses a completely different system than that of Dible, where RF power is supplied to a **conductive coil outside the plasma reactor chamber** according to a **matching circuit** having a primary

coil and a secondary loop. Examiner also refers to (col 5, lines 16-36) where Dible teaches with respect to the embodiment shown Figures 1(a) and 1(b) that the **inherent series capacitance** supplied by spacings (gaps) between the first and second electrodes "can be chosen to match the voltage requirements at each zone based on known RF phase and matching requirements".

The above teachings of Dible are clearly insufficient to teach or suggest Applicants invention including:

"delivering the RF power to each of a plurality of separate electrode zones **according to a matching network,** said RF power **individually deliverable to separate electrode zones** at a selected RF power level **according to a capacitor network comprising a plurality of variable capacitors arranged in parallel,** each of said separate electrode zones associated with one of said variable capacitors, said separate electrode zones comprising an electrostatic chuck"

On the other hand, Liu et al. disclose a method for optically monitoring the **integrated power spectra** by optical sensors (176; Figure 1; paragraph 0048) **located in an upper electrode** (60) over selected areas of a process wafer(50), where

the **upper electrode is segmented** (Figure 2A) and where **each segment** of the electrode **is supplied by a separate RF power supply** (82; Figure 2b, 2C) **each RF power supply controllable** to **alter the RF power of an individual electrode segment** (see Abstract; **each RF power supply is controllable to adjust the RF power level** of a plasma **based on differences in an integrated power spectra from a predetermined value** (paragraph 0018). **Liu et al. disclose monitoring the power spectrum over portions of the wafer face (see Figure 9; paragraph 0071) and teach that the magnitude of the total power spectrum should be the same over monitored portions of the wafer (Pa-Pc; Figure 9).** The RF power is adjusted to an electrode segment **to adjust the magnitude of the total power spectrum** to a predetermined value. Liu et al. teach that in achieving overall plasma processing uniformity in endpoint detection in an etching process may include predetermined application of **different RF power levels to the overhead electrode** as well as in-situ adjustment based on comparison **to a predetermined level of a magnitude of the power spectrum of the plasma** (paragraphs 0081 and 0082).

Examiner argues that it would have been obvious to modify Dible to incorporate plasma sensors in the apparatus of Dible et al."

However, even assuming *arguendo* that Dible could be successfully modified to incorporate the sensors of Liu to control separate RF power supplies supplying RF power to separate electrode segments Dible, such modification would change the principle of operation of Dible, make it unsuitable for its intended purpose, and still not produce Applicants invention.

Thus, the combination of Dible and Liu fails to disclose several elements of Applicants invention, including those elements in **bold type**:

"A method of controlling the **spatial distribution of RF power** used to generate a plasma for processing a semiconductor device process wafer to achieve a uniform density of said plasma **over an entire face of said process wafer,** comprising the steps of:

(a) **producing RF power from a single RF generator comprising a dual frequency system;**

(b) delivering the RF power to each of a plurality of separate electrode zones **according to a matching network,** said RF

power **individually deliverable to separate electrode zones** at a selected RF power level **according to a capacitor network comprising a plurality of variable capacitors arranged in parallel**, each of said separate electrode zones associated with one of said variable capacitors, said separate electrode zones comprising an electrostatic chuck; and

(c) separately controlling the RF power delivered to each of the electrode zones so as to produce a desired spatial distribution of RF power **in response to determining a density of said plasma across said process wafer face, said desired spatial distribution of RF power selected to achieve a uniform density of said plasma across said entire surface of said process wafer."**

"**First**, there must be some **suggestion or motivation**, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. **Second**, there must be a **reasonable expectation of success**. **Finally**, the prior art reference (or references when combined) **must teach or suggest all the claim limitations**. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's

disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

"The prior art must provide a motivation or reason for the worker in the art, without the benefit of appellant's specification, to make the necessary changes in the reference device." *Ex parte Chicago Rawhide Mfg. Co., 223 USPQ 351, 353 (Bd. Pat. App. & Inter. 1984).*

2. Claim 20 stands rejected under 35 USC 103(a) as being unpatentable over Dible et al. in view of Liu et al., above, and further in view of Strang (US 6,642,661).

Applicants reiterate the comments made above with respect to Dible et al. and Liu et al.

The further fact that Strang discloses a dual frequency generation system where both an RF power and a portion of an RF bias power (at different frequencies) is supplied to a segmented electrode overlying an unsegmented (single) wafer electrode which is also supplied with another portion of the RF bias power, , does not further help Examiner in producing Applicants invention.

Moreover, the apparatus of Strang works by a different

principle of operation than the apparatus of Dible (i.e., where only a **DC bias power** is disclosed in Dible, and where the RF power (no bias power) is supplied to a segmented electrode supporting the wafer and **where no matching network** is disclosed in Dible). Thus modifying Dible with the dual frequency network of Strang must also include the operation of the dual frequency power supply network of Strang where both an RF bias power and an RF power is supplied to an overlying segmented electrode and a bias RF power to a single electrode supporting a wafer. Such modification would change the principle of operation of Dible making the apparatus of Dible unsuitable for its intended operation, and still not produce Applicants invention.

Nowhere does Strang disclose or suggest if or how a dual frequency RF power system with a bias power and an RF power could successfully be supplied to a single segmented electrode as disclosed and taught in Dible.

"**First**, there must be some **suggestion or motivation**, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. **Second**, there must be a **reasonable expectation of success**. **Finally**, the prior art

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reference (or references when combined) **must teach or suggest all the claim limitations**. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)*.

"The prior art must provide a motivation or reason for the worker in the art, without the benefit of appellant's specification, to make the necessary changes in the reference device." *Ex parte Chicago Rawhide Mfg. Co., 223 USPQ 351, 353 (Bd. Pat. App. & Inter. 1984)*.

Conclusion

The cited references, individually or in combination, fail to produce or suggest Applicants invention and are therefore insufficient to make out a *prima facie* case of obviousness with respect to Applicants disclosed and claimed invention.

The claims have been amended to further clarify Applicants' disclosed and claimed invention. A favorable reconsideration of Applicants' claims is respectfully requested.

Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in condition for allowance for any reason, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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